Power Planning Briefing: Council's Power Planning Process

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Northwest Power and Conservation Council

Outline

- Demand and conservation assessment
- Generating resources
- Portfolio building

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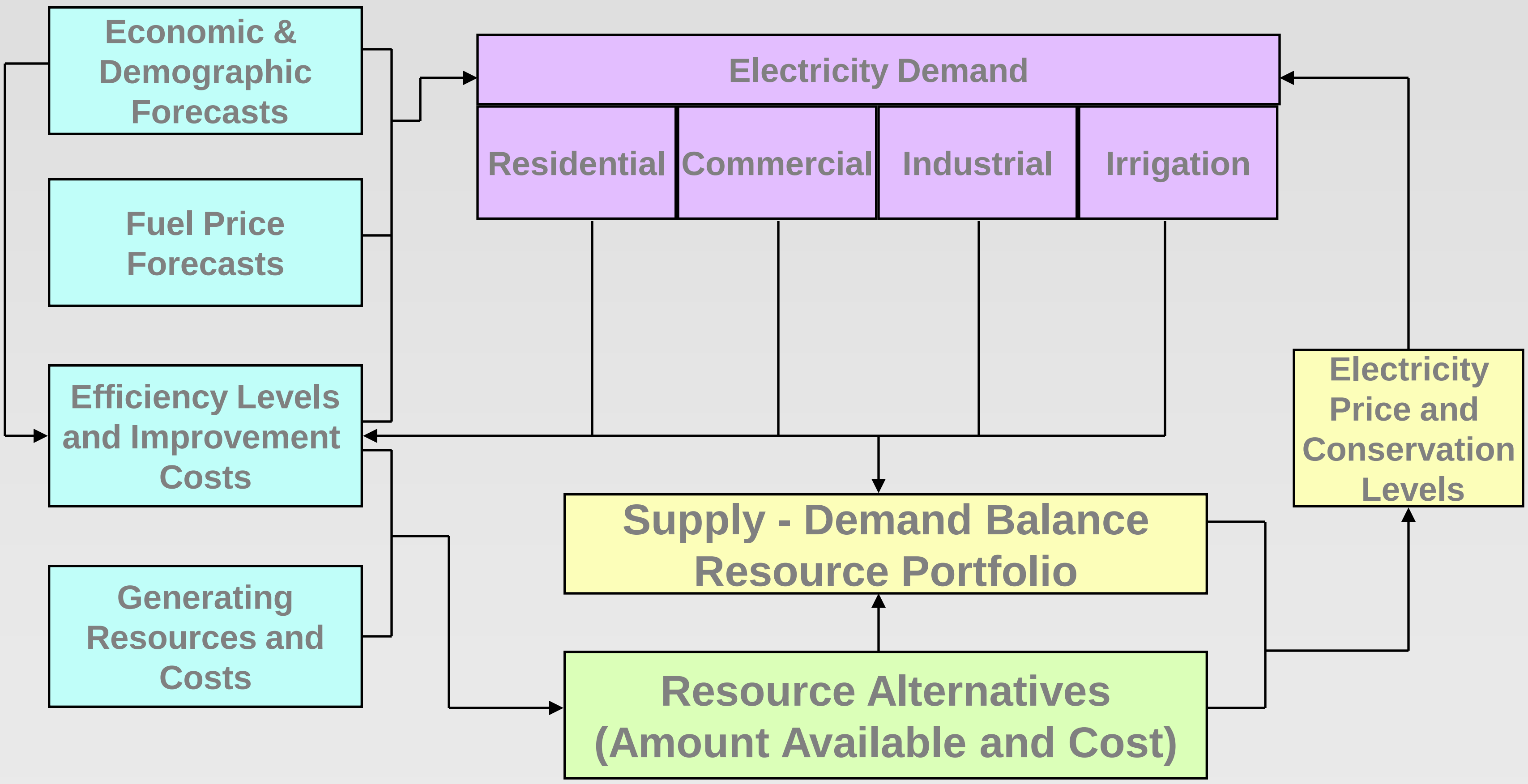
Council's Power Planning Process



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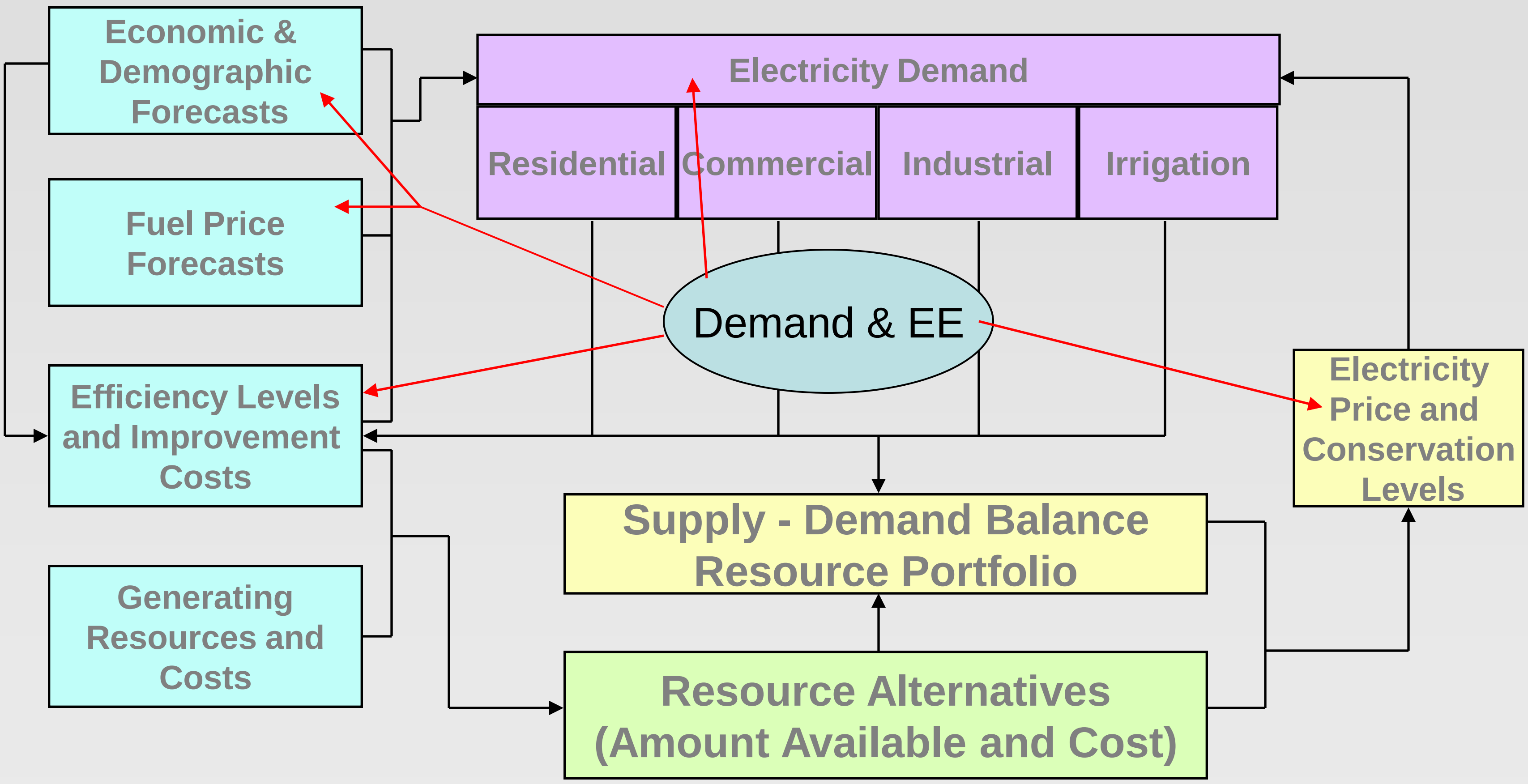

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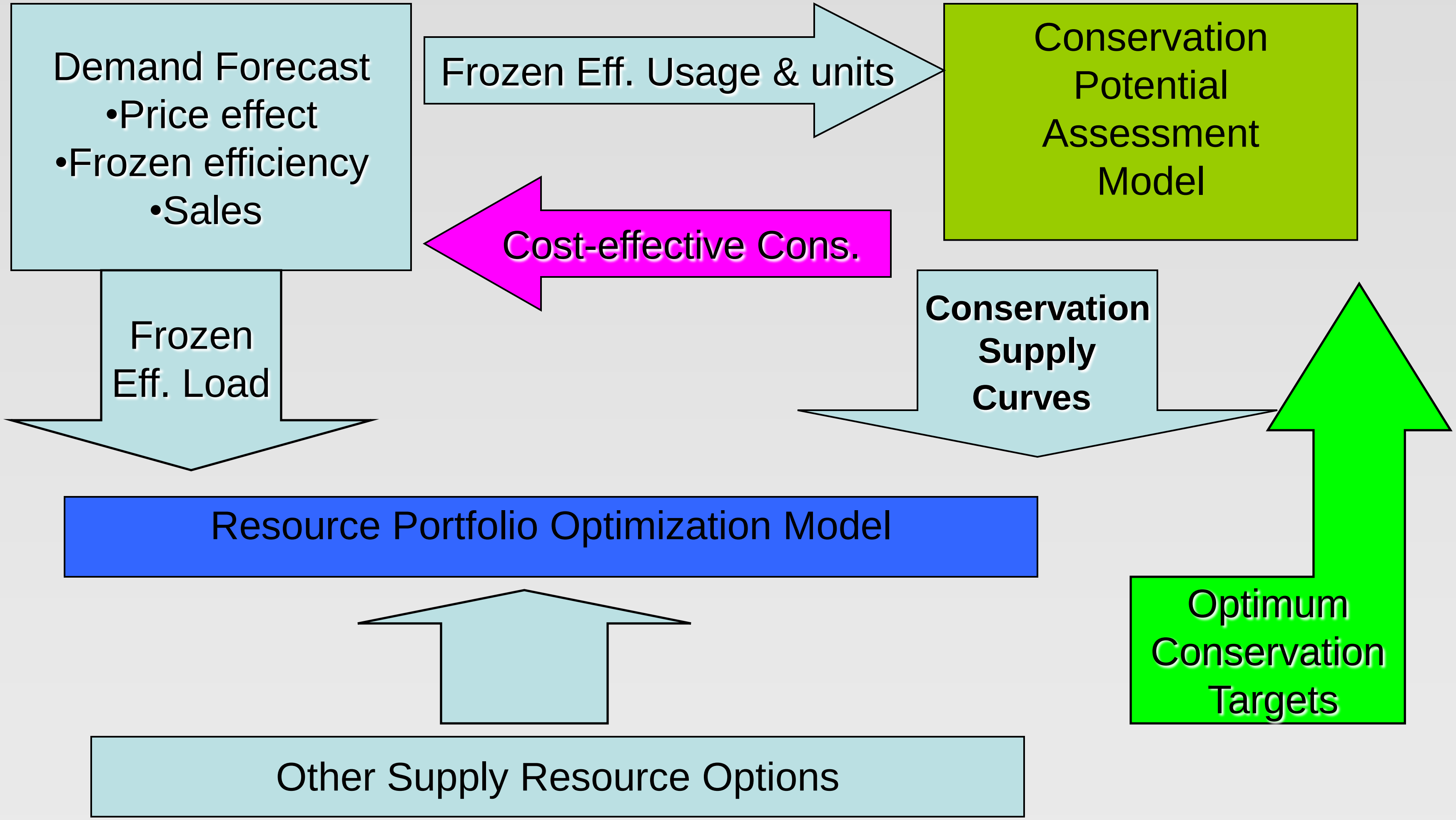
Demand forecast and Conservation Interface



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Basic Building Blocks of long-term Forecasting Model

For each enduse in each sector consumption is determined in part by:

- **Number of Units (A)**
- **Efficiency choices (B)**
- **Fuel choice (C)**

Energy use by an enduse = A * B * C

Number of Units (A)

- Driven by the economic forecast
  - Number of Existing home
  - Number of New Homes (Single, Multi, Manuf.)
  - Square footage of existing commercial buildings
  - Square footage of new commercial buildings
  - Level of production from industrial, agricultural and mining firms
  - Income of residential sector
- Source of information: (Global Insight and in-house analysis)
- Review: by State economists and Demand Forecasting Advisory Committee

Fuel Efficiency Choices (B)

Consumer choice that is critical to the energy decision making process is the Efficiency/capital cost trade-off

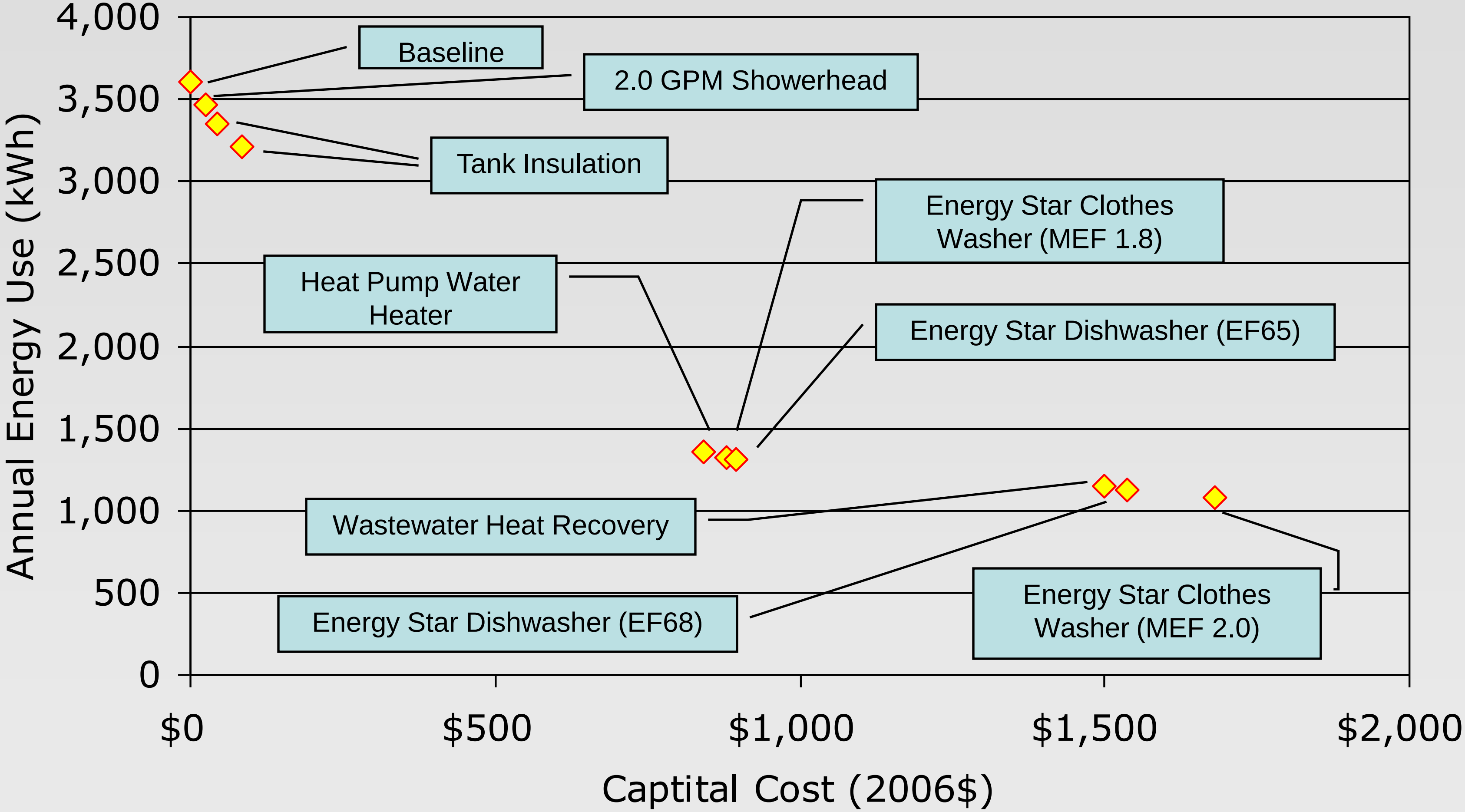
Trade-off between high up-front costs and high operating cost.

If a very high efficiency water heater is purchased, the capital cost will be large, however, the operating costs in the future will be lower than with a lower efficiency water heater.

Source of information: Various sources and studies (LBL, DOE,…)

Review process : Demand Forecast Advisory Group and In-house

Residential Hot Water Heating Efficiency Curve



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Fuel Choice (C)

- Deciding on fuel source on the basis of relative cost of fuels, cost factors considered include:
  - Capital Cost
  - Operation and maintenance cost
  - Non-price factors such as customer preference for one fuel over another

Six Step Process for Estimating Efficiency Potential

- Step 1 - Estimate ***Technical Potential*** *on a* ***per application*** *basis*
- Step 2 – Estimate ***Economic Potential*** *on a* ***per application*** *basis*
- Step 3 - Estimate number of ***applicable units***
- Step 4 – Estimate ***Technical Potential*** *for* ***all*** *applicable units*
- Step 5 - Estimate ***Economic Potential*** *for* ***all*** *applicable units*
- Step 6 – *Estimate* **Realizable Potential** *for* ***all*** ***realistically achievable*** *units*

The Basic Formula

Achievable Potential =

Number Units * Cost-Effective kWh per Unit * Market Penetration

Number Homes
Floor Area of Retail
Number of TVs
Acres Irrigated
Pounds Steel

(kWh/Unit at Current Efficiency – kWh/Unit at Cost-Effectiveness Limit of Efficiency)

Current Efficiency is adjusted for adopted codes & standards and stock turnover (Frozen Efficiency)

Cost-Effective Limit of Efficiency is estimated from Portfolio Model Results. It is based on the cost of the next lowest cost resource available to meet load.

Fraction realistically achievable over time

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Measures

Bi-radiant convection oven
Installation of high efficiency electric resistance water heater
Installation of high efficiency electric heat pump water heater
Installation of high efficiency electric solar water heater
Installation of flow control devices (showerhead/aerators)
Installation of pipe insulation
Installation of waste water heat recovery system
Manufactured/Mobile Homes New Shell Measures w/Forced Air Furnace Heating Zone 1
Manufactured/Mobile Homes New Shell Measures w/Forced Air Furnace Heating Zone 2
Manufactured/Mobile Homes New Shell Measures w/Forced Air Furnace Heating Zone 3
Manufactured/Mobile Homes New Shell Measures w/Heat Pump Heating Zone 1
Manufactured/Mobile Homes New Shell Measures w/Heat Pump Heating Zone 2
Manufactured/Mobile Homes New Shell Measures w/Heat Pump Heating Zone 3
Site Built New Shell Measures w/Baseboard Heating Equipment Zone 1
Site Built New Shell Measures w/Baseboard Heating Equipment Zone 2
Site Built New Shell Measures w/Baseboard Heating Equipment Zone 3
Site Built New Shell Measures w/Forced Air Furnace Heating Zone 1
Site Built New Shell Measures w/Forced Air Furnace Heating Zone 2
Site Built New Shell Measures w/Forced Air Furnace Heating Zone 3
Site Built New Shell Measures w/Heat Pump Heating Zone 1
Site Built New Shell Measures w/Heat Pump Heating Zone 2
Site Built New Shell Measures w/Heat Pump Heating Zone 3
Manufactured/Mobile Homes Retrofit Shell Measures w/Forced Air Furnace Heating Zone 1
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Site Built Retrofit Shell Measures w/Forced Air Furnace Heating Zone 3

Retrofit Commercial Lighting: F96T12 to T8HP
Retrofit Commercial Lighting: F96T12HO to T8HP-4
Retrofit Commercial Lighting: F96T12VHO to T8HP-4
Retrofit Commercial Lighting: T8-2 to T8HP-2
Retrofit Commercial Lighting: T8-3 to T8HP-2
Retrofit Commercial Lighting: T8-4 to T8HP-3
Retrofit Commercial Lighting: MH to MHPS
Retrofit Commercial Lighting: Med MH to T8HP
Retrofit Commercial Lighting: Large MH to T5HO
Retrofit Commercial Lighting: Small MH to CF-R
Retrofit Commercial Lighting: INC to CMH
Retrofit Commercial Lighting: INC to CFL
Retrofit Commercial Lighting: MR to MR/IR
Top Daylighting: Linear Fluorescent 3-Step Dim
Top Daylighting: Linear Fluorescent Continuous Dim
Top Daylighting: Metal Halide Base 1-Step Dim
Top Daylighting: Six permutations of control density & geometry
ECM on VAV Boxes-New
7.5 tons EER 10.1 to 11.0
<5 tons and >15 tons EER 9.5 to 11.0
Chiller upgrade
Glass: code to al36
Glass: code to al40
Glass: code to al45
Glass: code to vea
Glass: codet to al36tint
Glass: codet to al40tint
Glass: codet to al45tint
Glass: codet to veat
Glass: codet to vet
Glass Retrofit: sngl to al36 CW
Glass Retrofit: sngl to al40 CW
Glass Retrofit: sngl to al45 CW
Glass Retrofit: sngl to vea
Glass Retrofit: sngl to al40
Optimize/repair economizer/controller/t-stat
Demand Control Ventilation where applicable
Morning warm-up control logic
Refrigerant charge correction
Coil Cleaning
One-chiller baseline
Two-chiller baseline
Under Floor Air Distribution (UFAD)
Dedicated Outdoor Air Supply (DOAS)
VFD, VSD for fans

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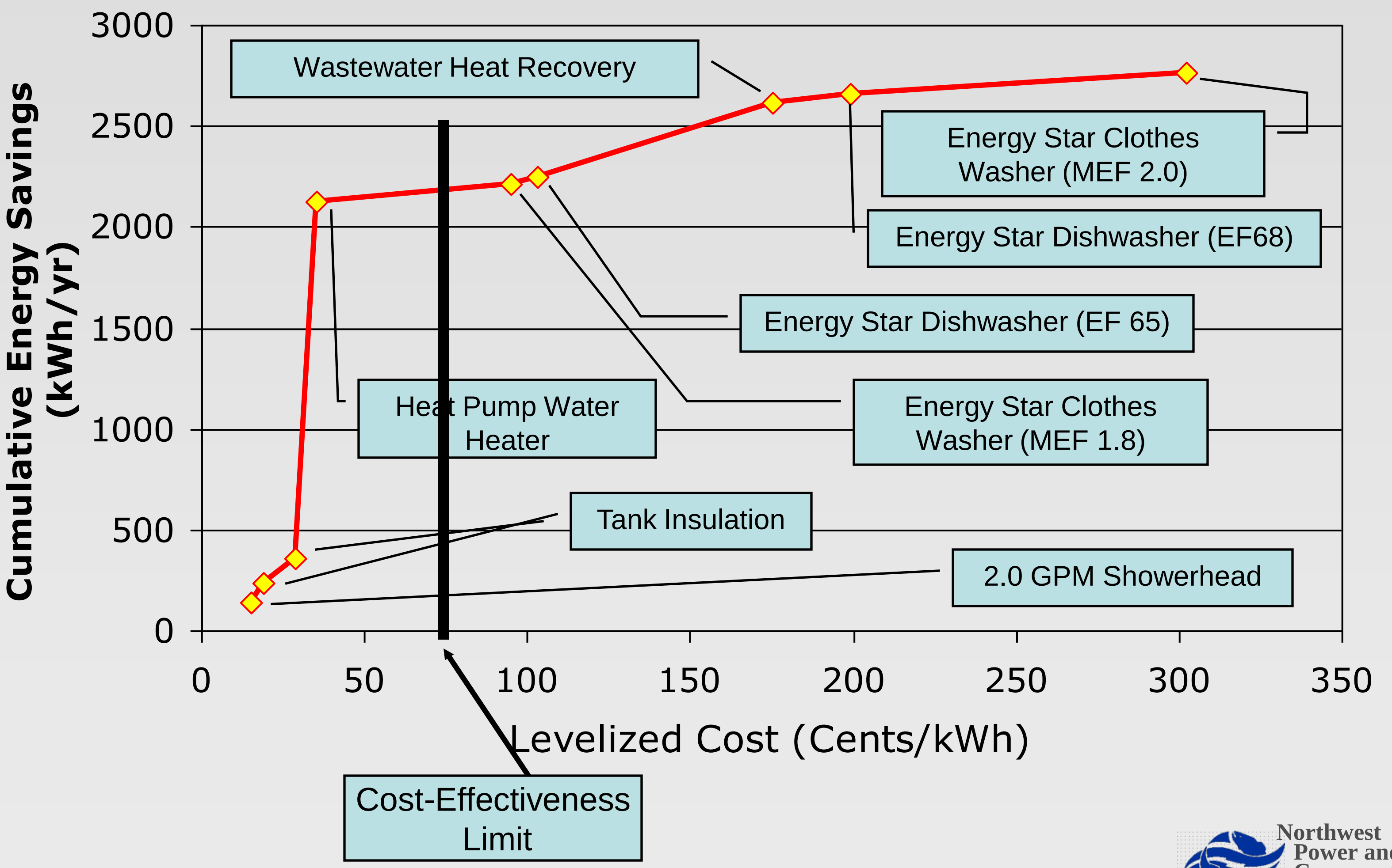
Residential Hot Water Heating Dwelling Unit Supply Curve



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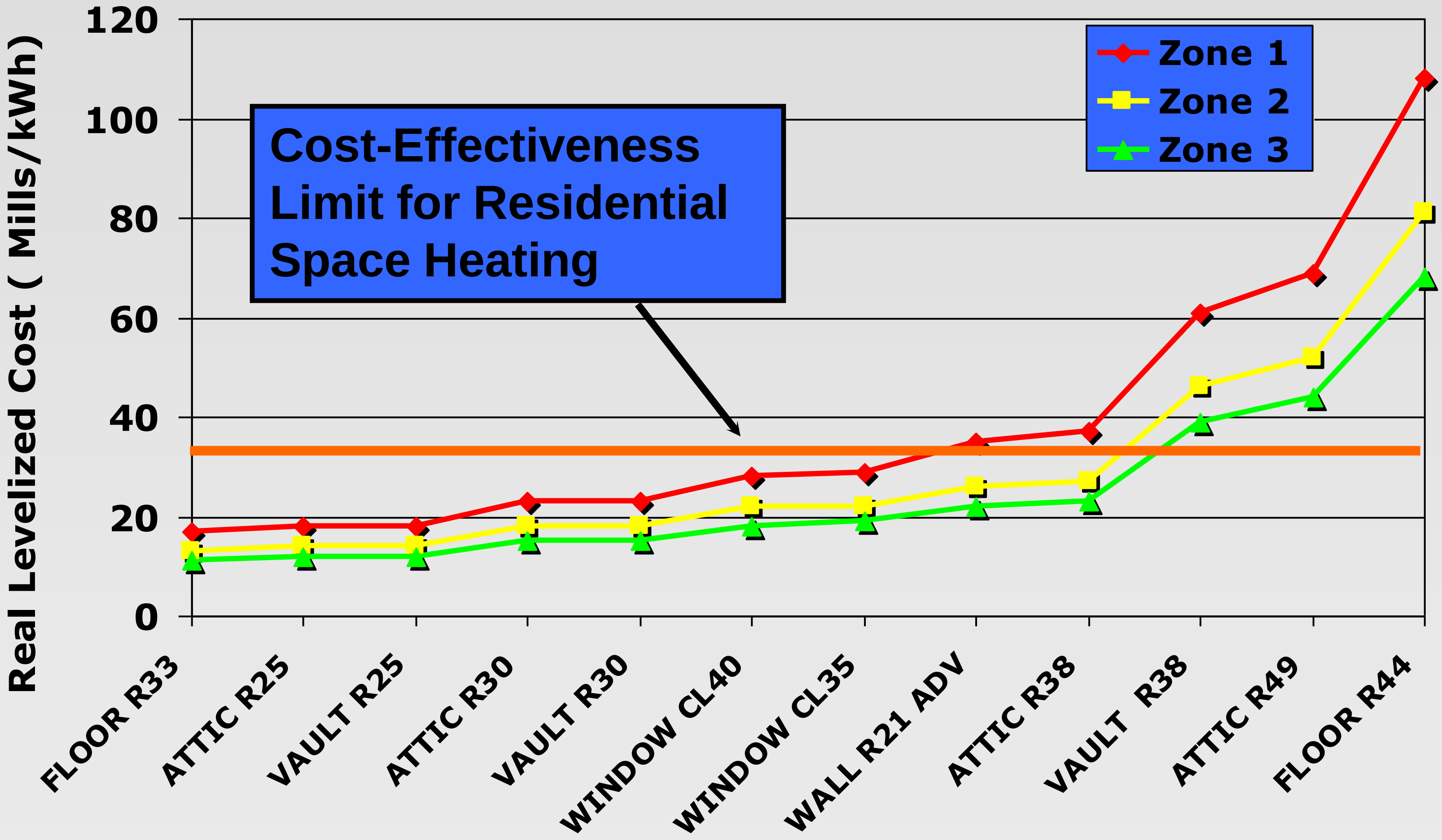
What Is "Cost-Effective"?

- ***"Cost-effective,"*** means that a measure or resource must be forecast:
  - to be *reliable and available* within the time it is needed
  - to meet or reduce the electric power demand of the consumers *at an estimated incremental system cost no greater than that of the least-cost similarly reliable and available alternative* measure or resource, or any combination thereof.
- Conservation's **"*cost-effectiveness limit"*** is set at or below **110%** of the cost of the next similarly available and reliable lower priority resource

Illustrative “Unit Level” Cost-Effectiveness Assessment

Simple Case – Residential Space Heating for New Manufactured Homes



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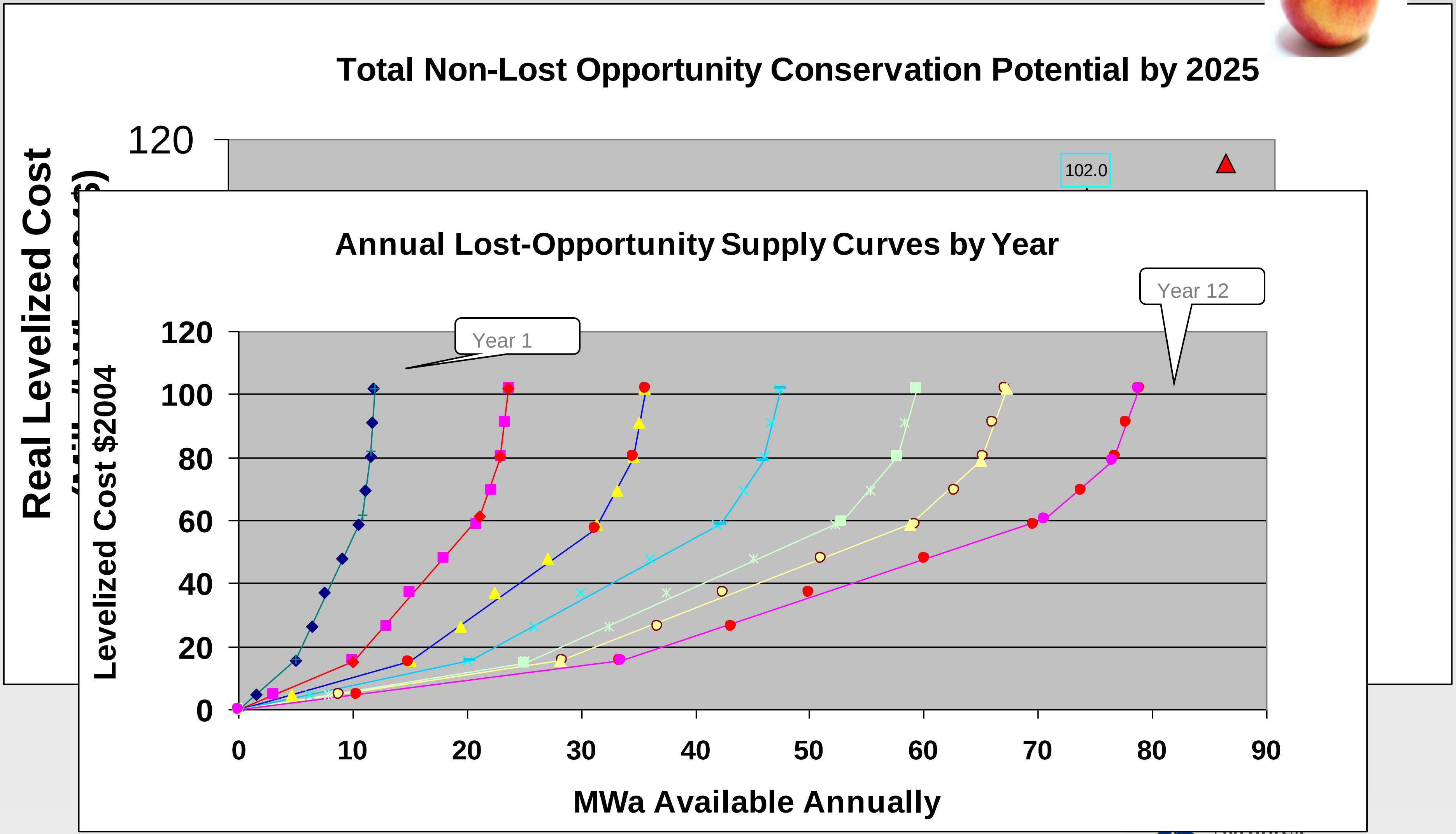
Council Supply Curves



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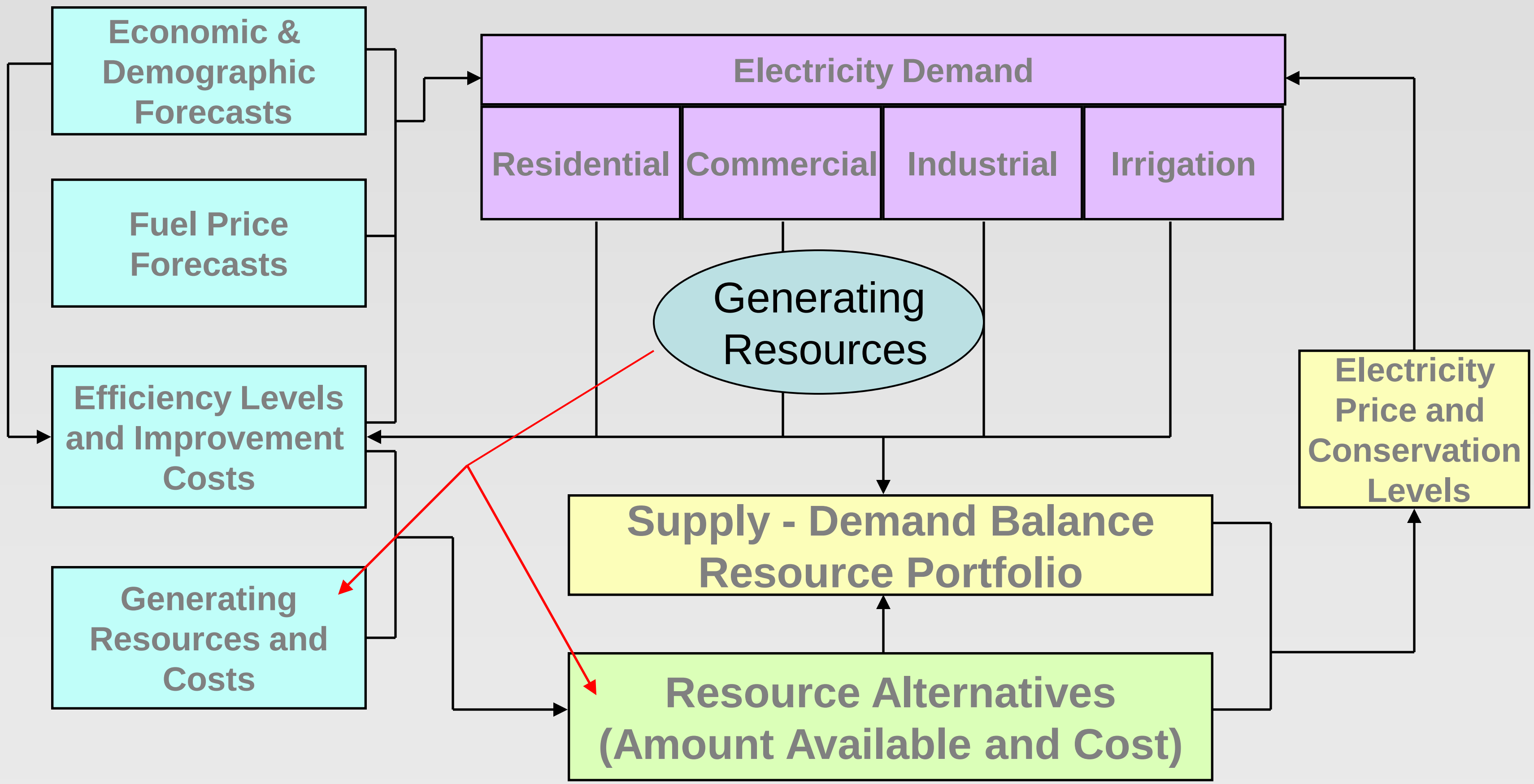

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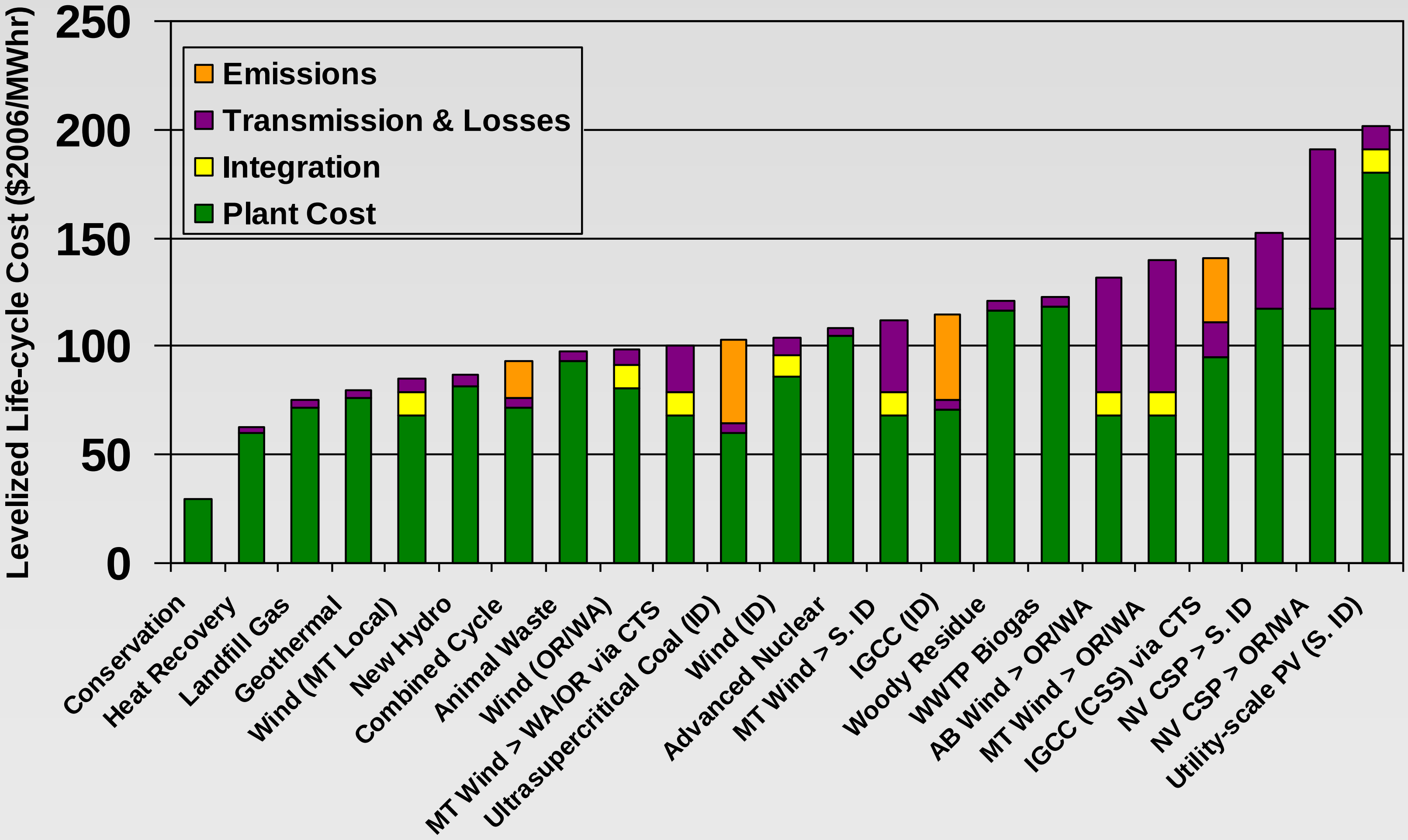
Resource Costs: Long Term



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Major Future Resource Options

	Application	Earliest Service	Capacity Cost ($/kW/yr)	Energy Cost ($MW)
Gas combined-cycle	Energy Flexible Capacity	2014	$136	$60 + $9
Gas peaking units	Flexible Capacity Energy	2013	$108	$73 + $12
Wind	Energy	2011	n/a	$76[a] + $0
Coal gasification combined-cycle w/CSS	Energy Capacity	Ca. 2017	$367	$73 + $2[b]
Nuclear	Energy Capacity	Ca. 2021	$363	$54 + $0
Solar-thermal (Import)	Energy Capacity (Limited)	2014	N/est.	N/est.

a) Class 6 (Good) wind site, no PTC, no transmission expansion cost.

b) 90% CSS (50% CSS case to be developed)

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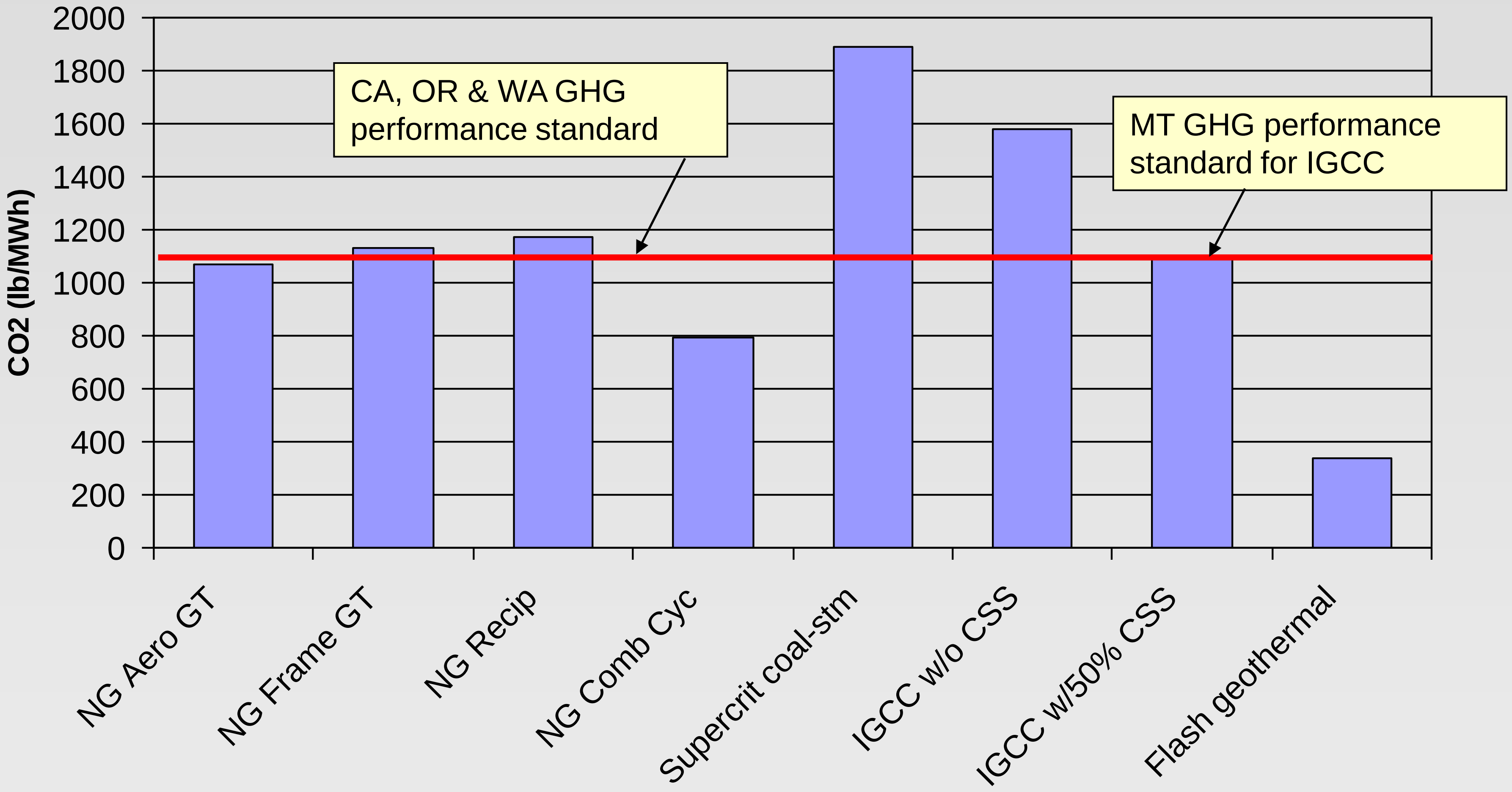
Statutory Resource Constraints

- Renewable portfolio standards
  - Mandated acquisition of certain resources
  - End targets (sales-based):
    - MT 15% by 2015 (IOUs)
    - OR 25% by 2025 (large utilities)
    - WA 15% by 2020 (larger utilities)
- GHG emission performance standards
  - Long-term acquisition of baseload resources
  - OR & WA (& CA) - 1100 lbCO2/MWh
  - MT - 50% CO2 capture & sequestration (HB 25)

CO_2 Production Rates



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Power Resource Risks

Costs and Considerations

- Construction Risk
  - Responding fast enough to capture value
  - Sunk siting and permitting costs
  - Construction materials cost
  - Mothball and cancellation costs
- Operation Risk
  - Fuel, maintenance, and labor costs
- Retirement Risk
  - Carrying the forward-going fixed cost of an unused plant
  - Undervaluing and retiring a plant that may have value in the future

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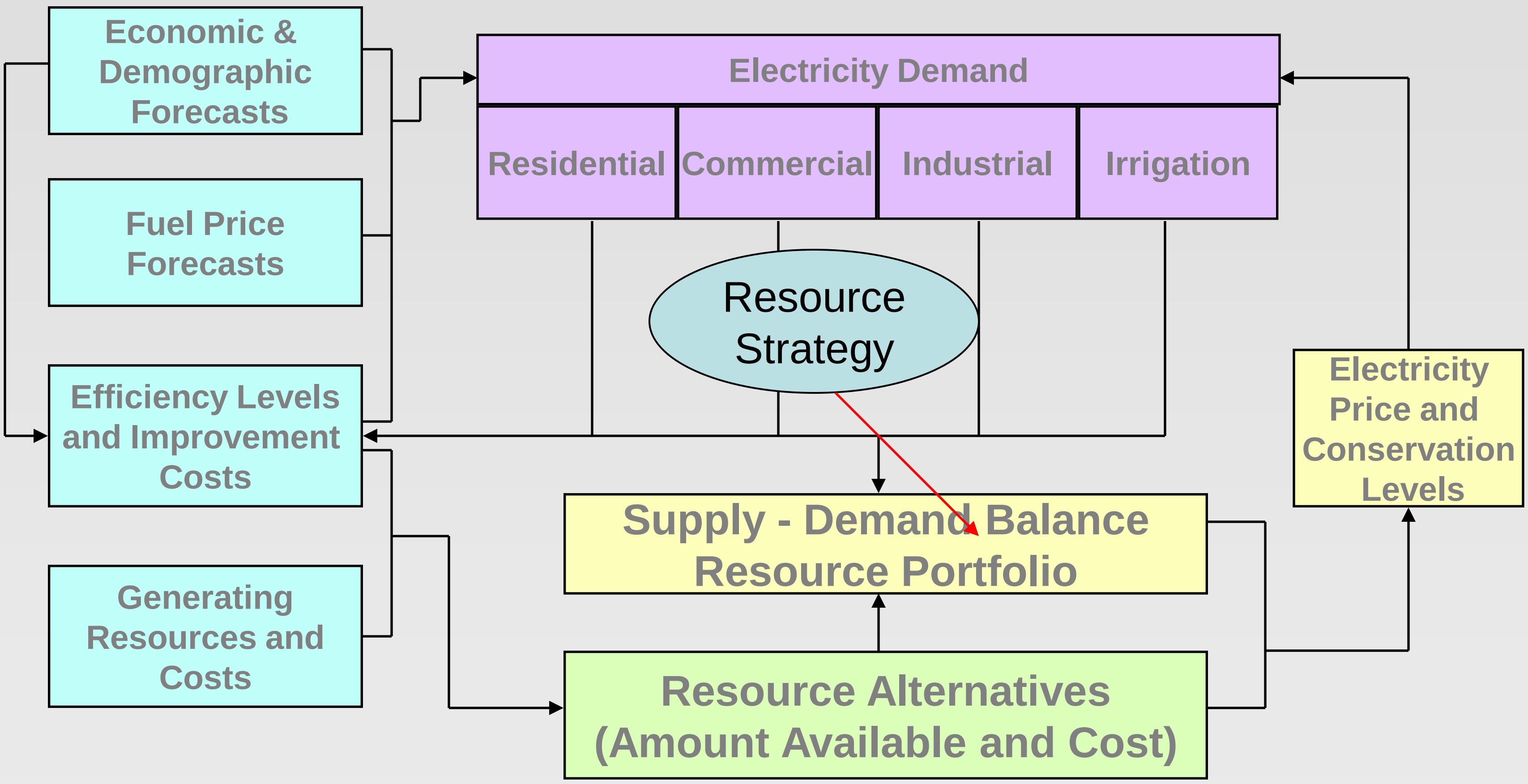

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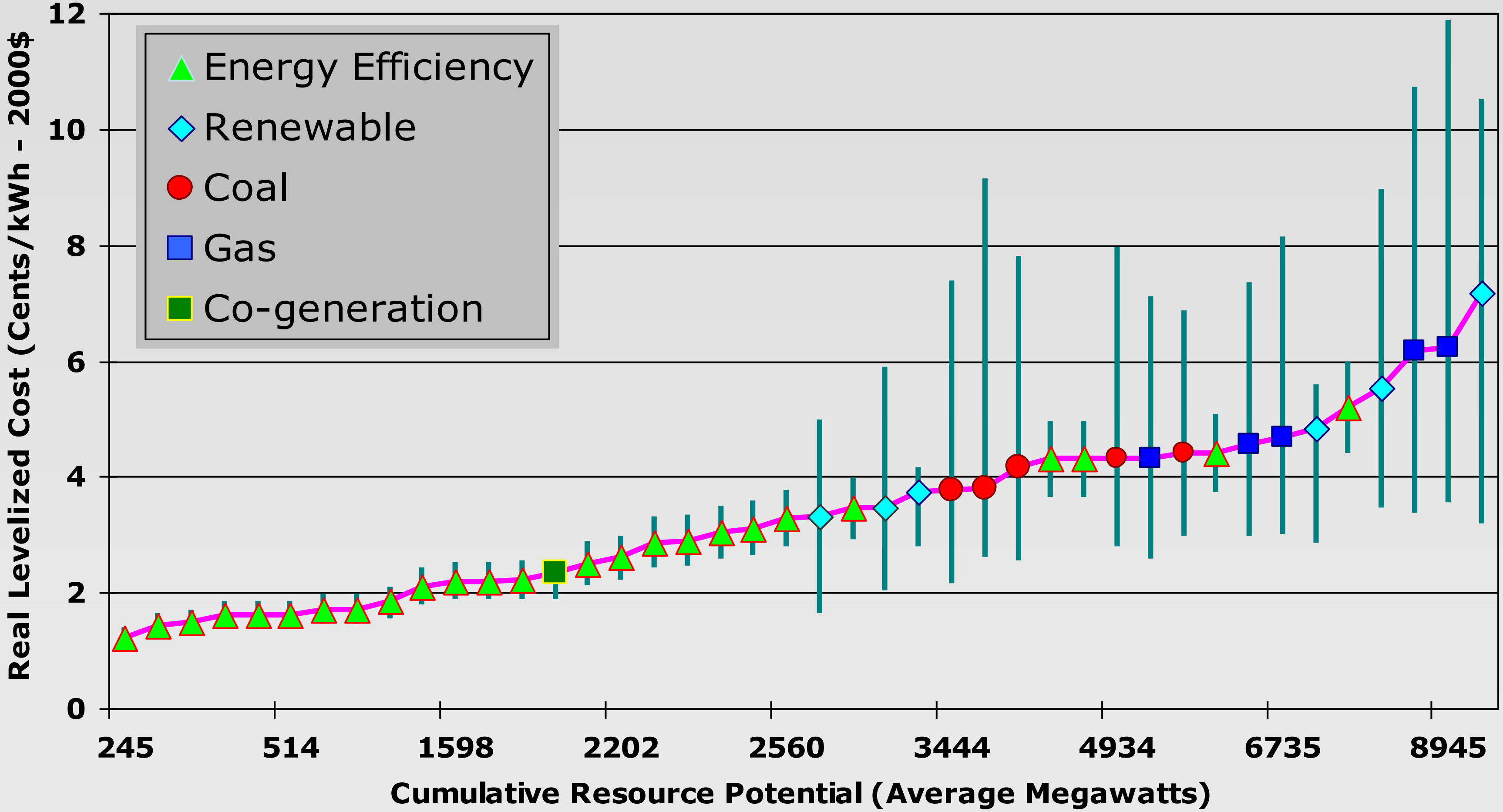
Resource Supply Curve



Resource potential for generic coal, gas & wind resources shown for typical unit size. Additional potential is available at comparable costs.

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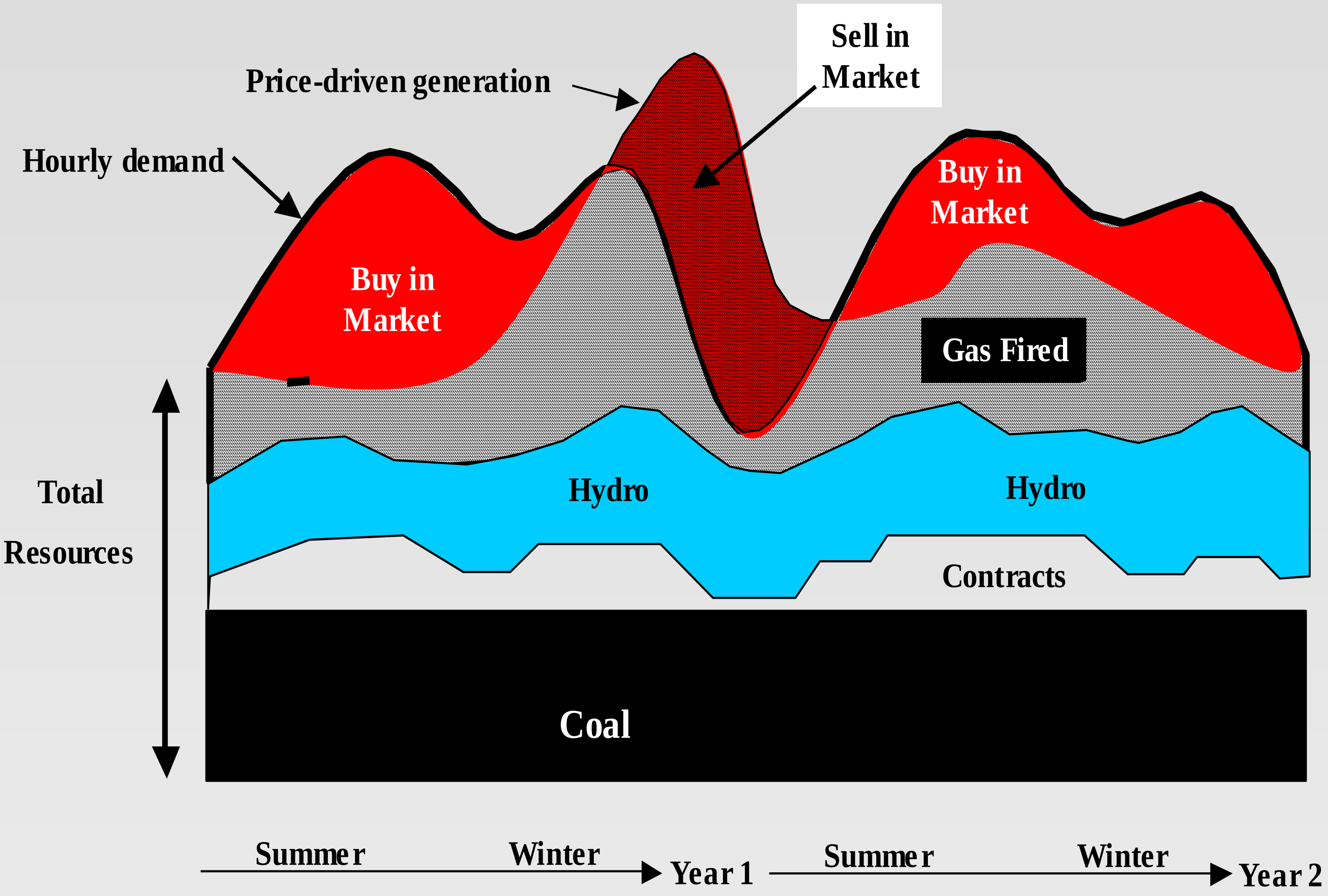
The Portfolio Model: A Different Kind of Risk Modeling

- Imperfect foresight and use of decision criteria for capacity additions
- Adaptive plans that respond to futures
  - Primarily options to construction power plants or to take other action
  - May include policies for particular resources
- “Scenario analysis on steroids”
  - 750 futures, strategic uncertainty
  - Frequency that corresponds to likelihood

Operating Costs



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Background on the Efficient Frontier

Because we face uncertainty, we need to find "*Plans*" that perform well over wide range of possible *"Futures"*

- *Futures* -- possible combinations of hydro conditions, loads, fuel prices, market prices, CO_2 penalties and so on over planning period
- *Plans* – types and amounts of resources and earliest "be prepared to start construction" dates (options)

…And a Bit More Abstractly…

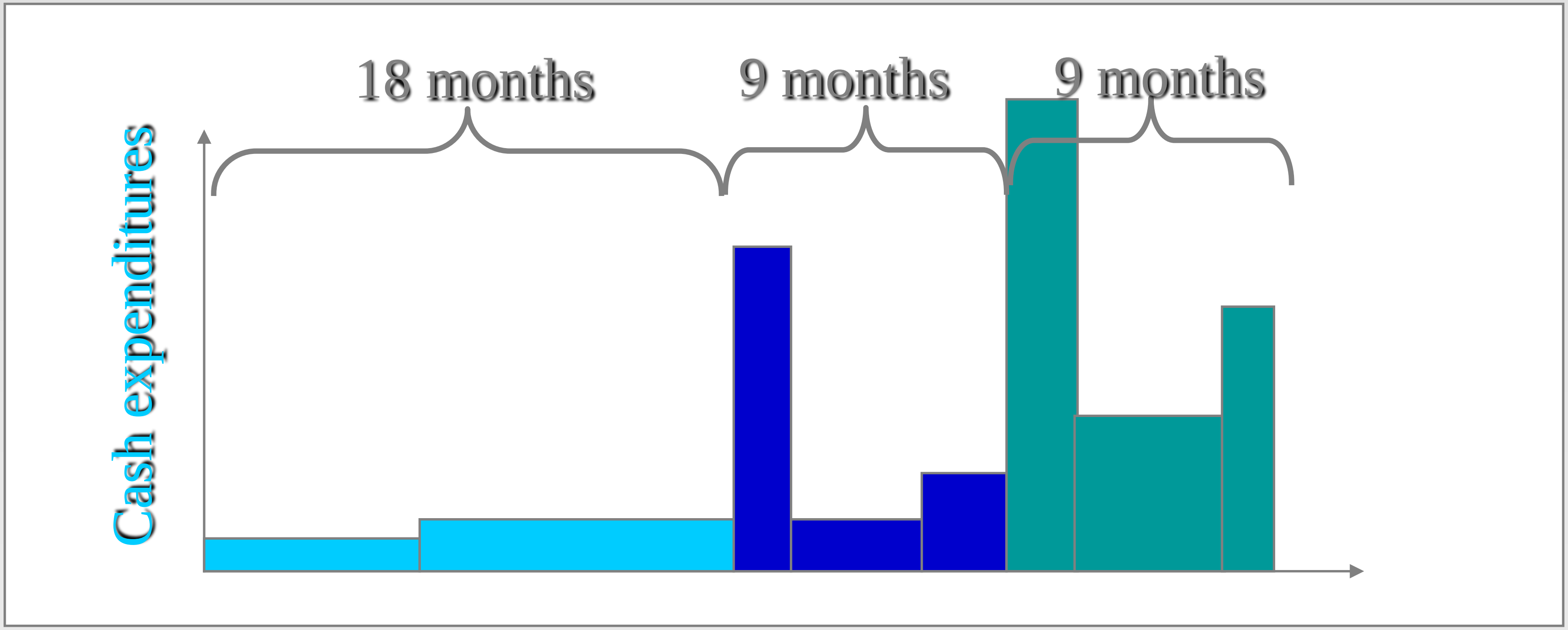
- *Futures* – circumstances over which the decision maker has no control that will affect the outcome of decisions
- *Plans* – actions and policies over which the decision maker has control that will affect the outcome of decisions

Sources of Uncertainty

Load requirements
Gas price
Hydrogeneration
Electricity price
Forced outage rates
Aluminum price
CO2 tax
Production tax credits
Green tag value (Renewable Energy Credit)

The Construction Cycle

- After an initial planning period, there typically large expenditures, such as for turbines or boilers, that mark decision points.



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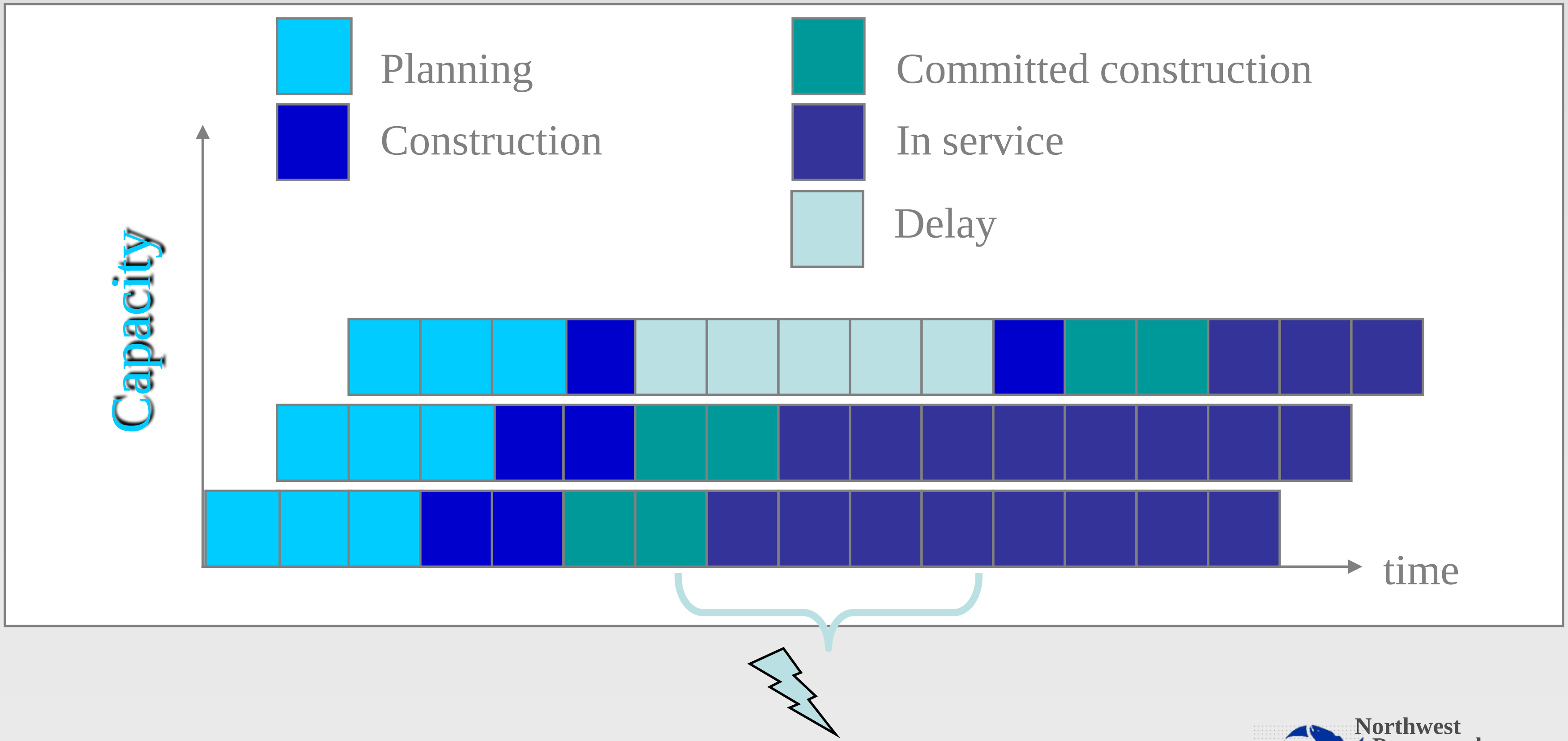
Modeling Cohorts

- Each period can have a cohort of plants, usually of different size or capacity
- All cohorts will be affected by changing circumstances, but may be at different stages of development



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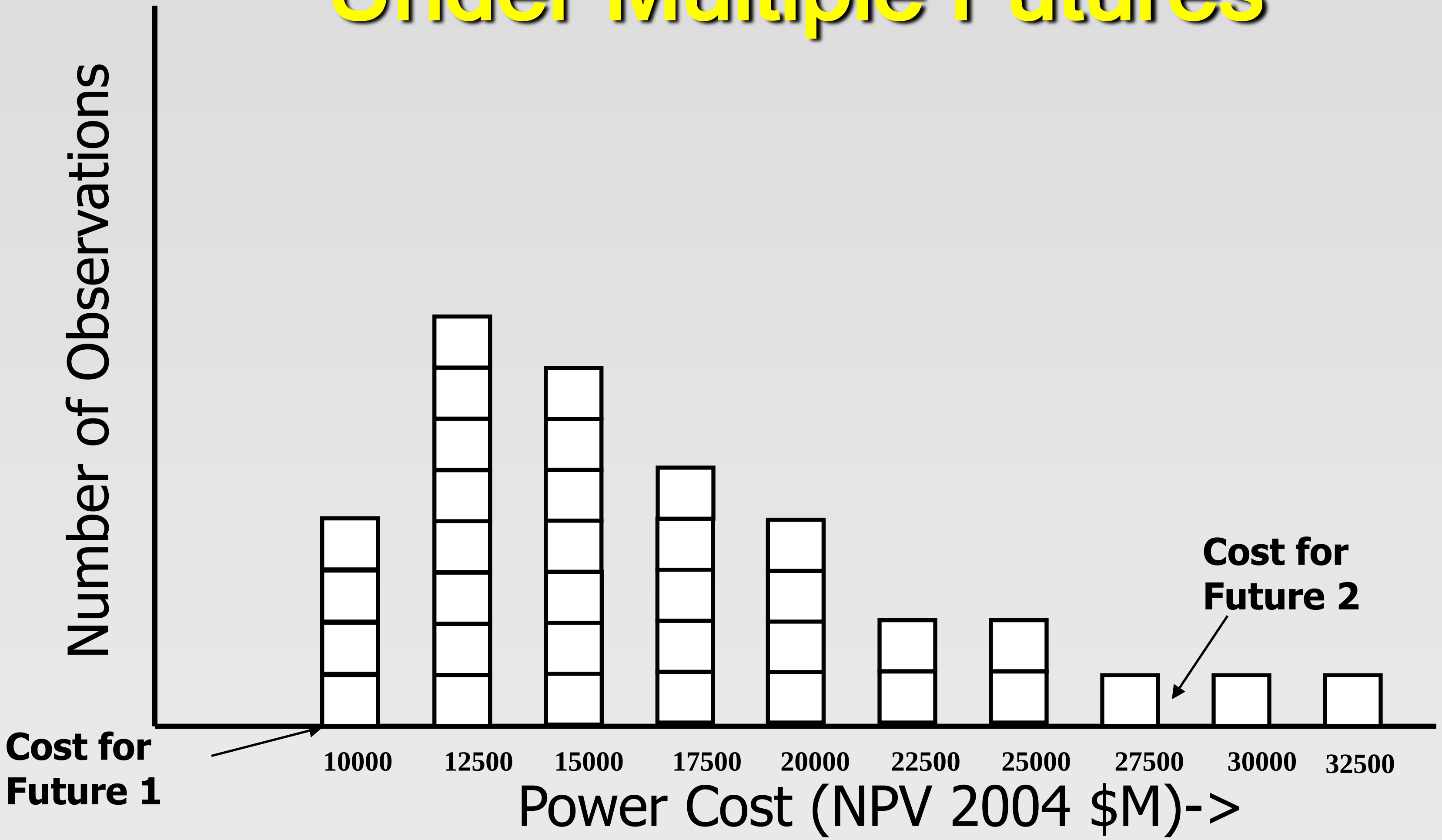
Resource Plan

Additions in Megawatts

Beginning of year	2008	2010	2012	2014	2016	2018	2020	2024
CCCT	0.00	0.00	0.00	0.00	0.00	610.00	1,220.00	
SCCT	0.00	0.00	0.00	0.00	0.00	100.00	800.00	
Coal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Demand Response	500.00	750.00	1,000.00	1,250.00	1,500.00	1,750.00	2,000.00	
Wind_Capacity	0.00	100.00	1,500.00	2,400.00	4,400.00	5,000.00	5,000.00	
IGCC	0.00	0.00	425.00	425.00	425.00	425.00	425.00	
Conservation cost-effectiveness premium over market	10.00	5.00						
avg New Conservation	443	746	1071	1416	1774	2020	2198	2500

These dates represent the earliest that construction would begin. All siting, licensing, and other preparation must be completed by these dates. The earliest in-service dates are 2 years later for CCCT, 1 year for SCCT, 3 years six months for Coal, and 1 year for Wind, due to construction time requirements. Wind energy assume a 30 percent availability. Turbines have 5 percent forced outages.

Distribution of Cost for a Plan Under Multiple Futures



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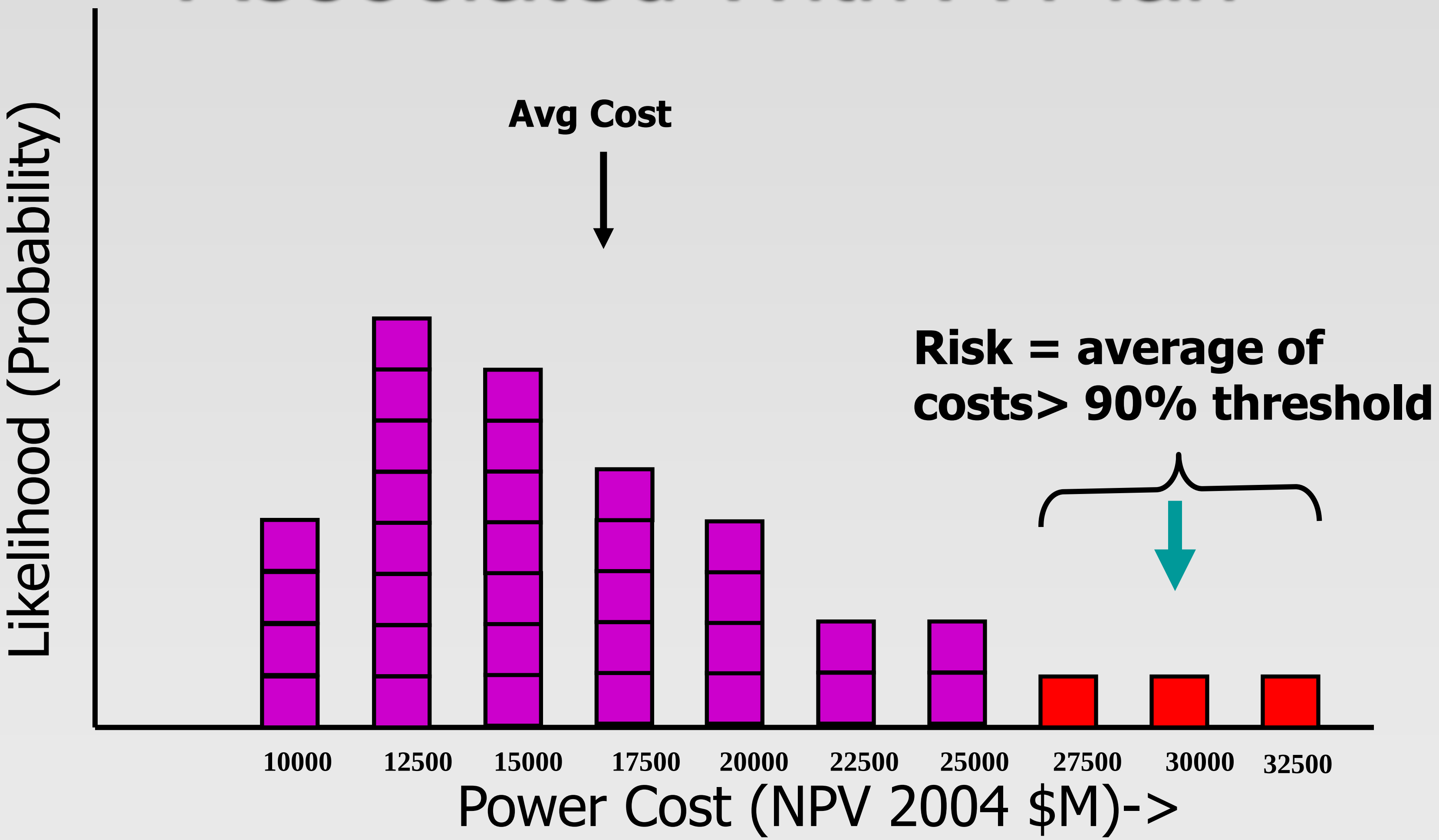
Risk and Expected Cost Associated With A Plan



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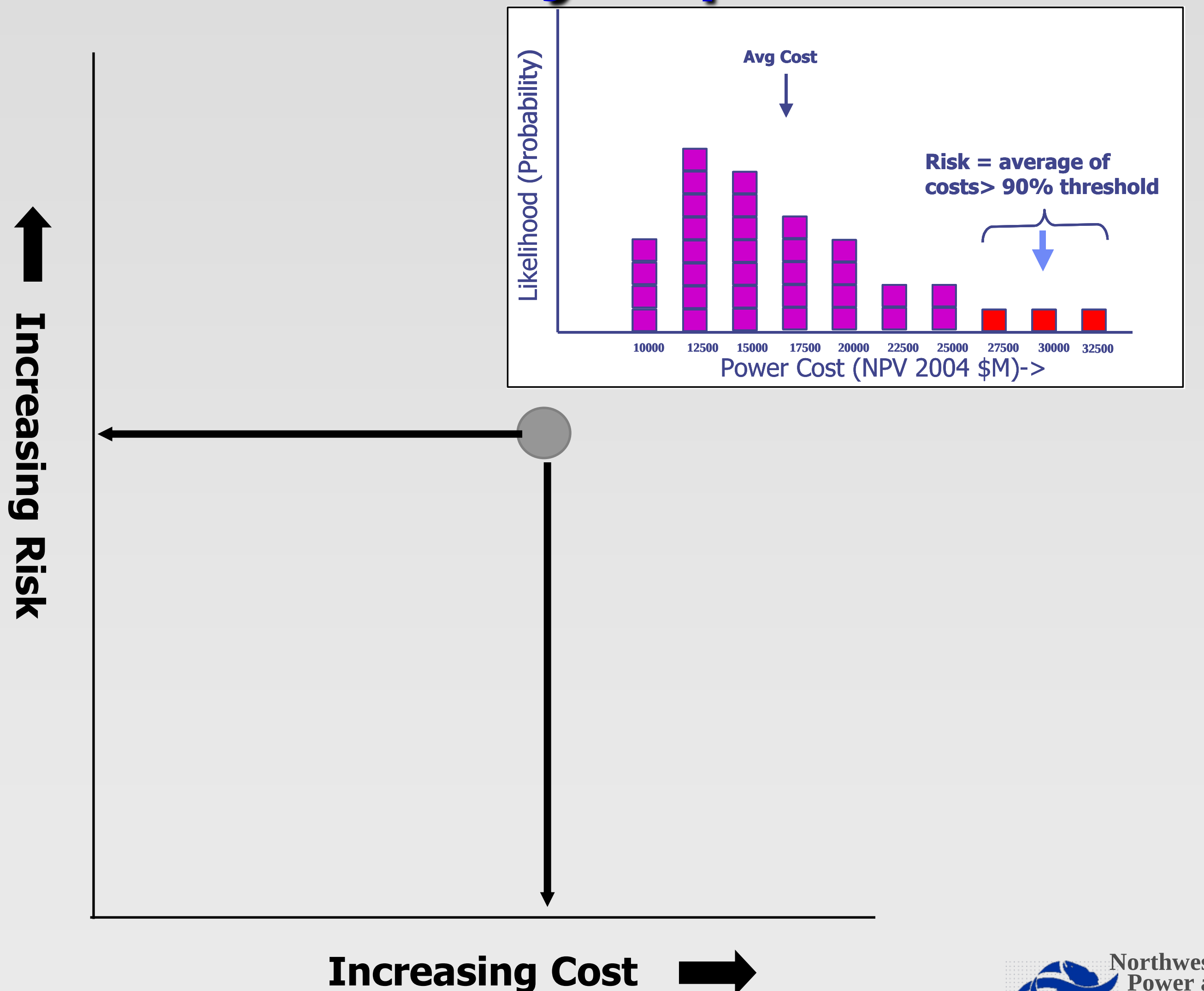
Feasibility Space



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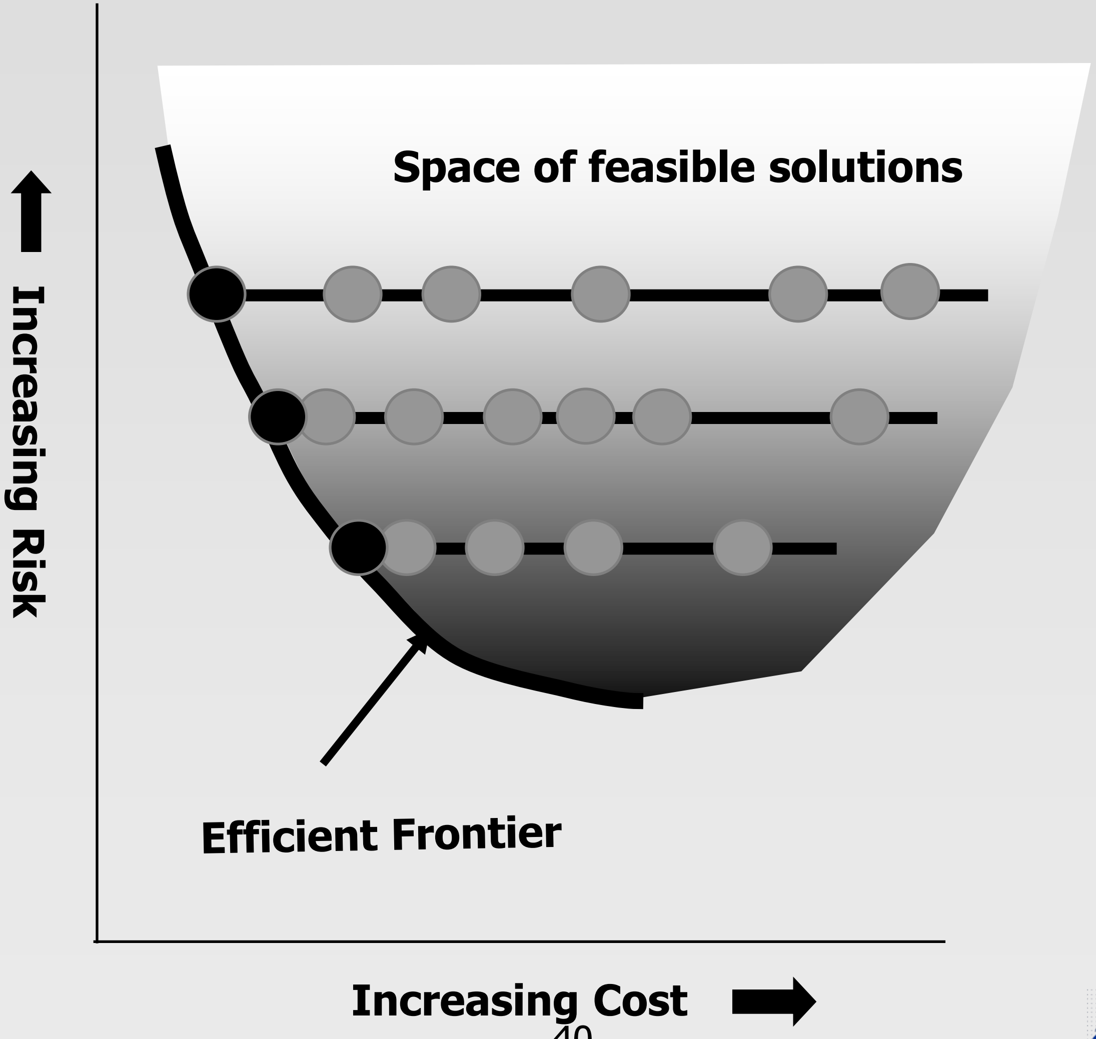

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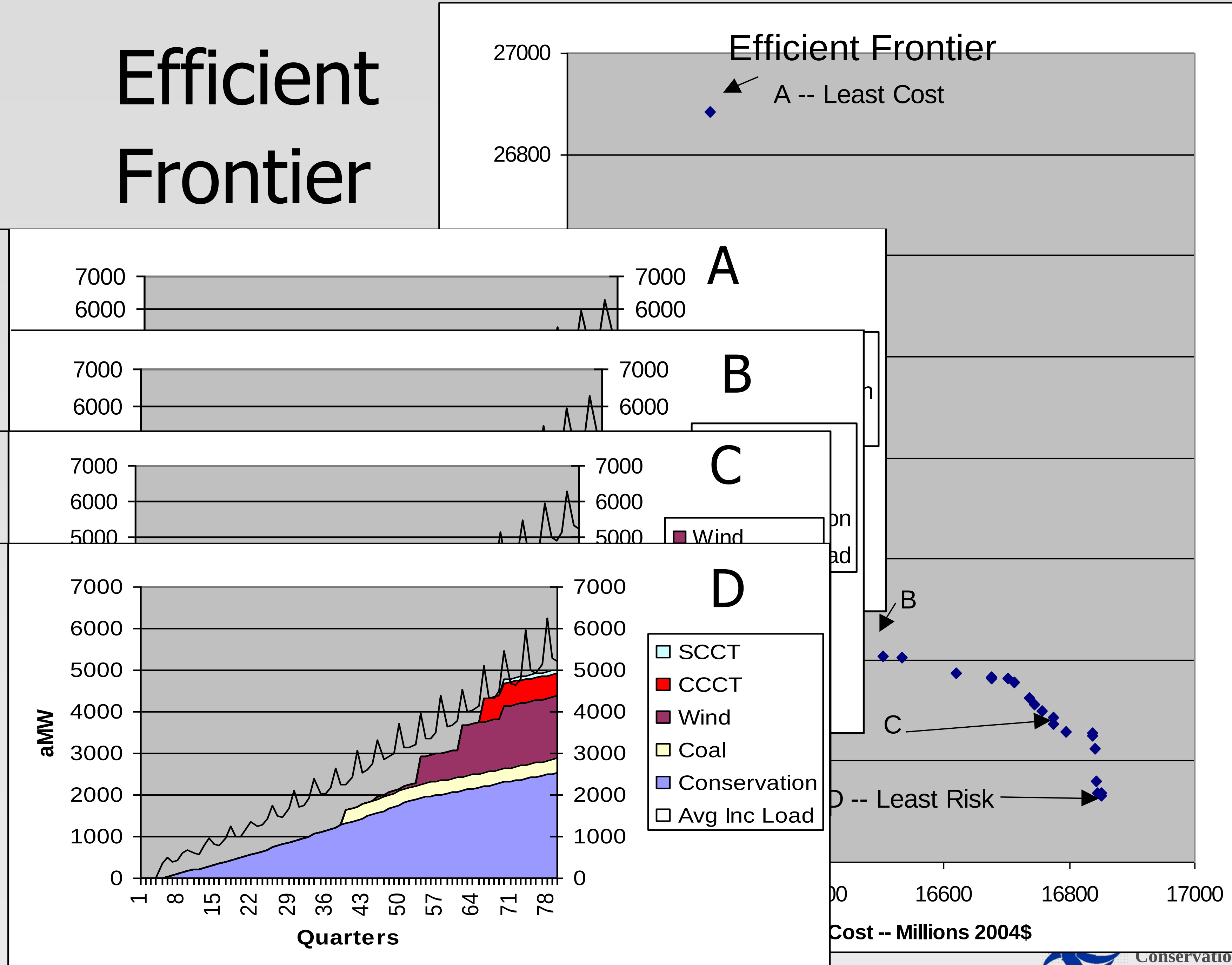
Efficient Frontier



Background